SRM-iRODS Interface Development

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What is iRODS

- Integrated Rule-Oriented Data-management System
- From SRB (Storage Resource Broker) to iRODS
- A community-driven, open source, data grid software solution
iRODS Architecture

User
Can Search, Access, Add and Manage Data & Metadata

iRODS Data System

iRODS Data Server
Disk, Tape, etc.

iRODS Rule Engine
Track policies

iRODS Metadata Catalog
Track data
iRODS features

- High-performance network data transfer
- A unified view of disparate data
- Support for a wide range of physical storage
- Easy back up and replication
- Manages metadata
- Controlled access
- Policies, Rules and Micro-services
- Workflows
- Management of large collections
iRODS Applications

- Data grids
  - Project level data sharing
- Digital libraries
  - Specify data context, provide standard services
- Persistent archive
  - Build reference collections
- Real-time sensor systems
  - Manage real-time data distribution
- Workflow systems
  - Integrate client- & server-side workflows

- Share data
- Publish data
- Preserve data
- Federate data
- Analyze data
Why SRM?

- Storage Elements (SE) can use different types of technologies
  - CASTOR, dCache, DPM, BeStMan, ..., etc.
  - DRM (Disk Resource Manager)/TRM (Tape Resource Manager)/HRM (Hierarchical Resource Manager)

- Grid middleware needs to access files with an uniform interface
  - Manage storage resources
  - Not a file transfer protocol
What is SRM?
What is SRM?

- **Storage Resource Managers (SRMs) are middleware components**
  - whose function is to provide
    - dynamic space allocation
    - file management
  - on shared storage resources on the Grid
- Different implementations for underlying storage systems are based on the same SRM specification
SRM features

- Provides space management
- Provides an uniform access interface
- Manages DRM/Tape/HRM
- Does not transfer files itself.
- Manage the life time of file
SRMs role in the data grid architecture

- Shared storage space allocation & reservation
  - important for data intensive applications
- Get/put files from/into spaces
  - archived files on mass storage systems
- File transfers from/to remote sites, file replication
- Negotiate transfer protocols
- File and space management with lifetime
- support non-blocking (asynchronous) requests
- Directory management
- Interoperate with other SRMs
SRM: Main concepts

- Space reservations
- Dynamic space management
- Pinning file in spaces
- Support abstract concept of a file name: Site URL
- Temporary assignment of file names for transfer: Transfer URL
- Directory management and authorization
- Transfer protocol negotiation
- Support for peer to peer request
- Support for asynchronous multi-file requests
- Support abort, suspend, and resume operations
- Non-interference with local policies
SRM v2.2 Interface

- **Data transfer functions** to get files into SRM spaces from the client's local system or from other remote storage systems, and to retrieve them
  - `srmPrepareToGet`, `srmPrepareToPut`, `srmBringOnline`, `srmCopy`

- **Space management functions** to reserve, release, and manage spaces, their types and lifetimes.
  - `srmReserveSpace`, `srmReleaseSpace`, `srmUpdateSpace`, `srmGetSpaceTokens`

- **Lifetime management functions** to manage lifetimes of space and files.
  - `srmReleaseFiles`, `srmPutDone`, `srmExtendFileLifeTime`

- **Directory management functions** to create/remove directories, rename files, remove files and retrieve file information.
  - `srmMkdir`, `srmRmdir`, `srmMv`, `srmRm`, `srmLs`

- **Request management functions** to query status of requests and manage requests
  - `srmStatusOf{Get,Put,Copy,BringOnline}Request`, `srmGetRequestSummary`, `srmGetRequestTokens`, `srmAbortRequest`, `srmAbortFiles`, `srmSuspendRequest`, `srmResumeRequest`

- **Other functions** include Discovery and Permission functions
  - `srmPing`, `srmGetTransferProtocols`, `srmCheckPermission`, `srmSetPermission`, etc.
When iRODS met SRM

- Make iRODS an archival system of gLite-based e-Infrastructure.
- Support flexible lifetime policy for files
- Impose the VO-based resource policy and security control to iRODS as the Grid infrastructure.
SRM-iRODS implementations
SRM-iRODS Architecture
Information in Auxiliary File Catalog

• AMGA server, it stores partial filecatalog, resource and SRB host information…
  • Users Information
  • Resources Information
  • Files Information
  • Space Metadata
  • Resource States
  • …
Architecture Overview

Put a file (SURL)

Web Service

Core

Auxiliary filecatalog
(AMGGA)

Data server management

iCAT Server
(GSI enabled)

Non iCAT
(+DSI)

Non iCAT
(+DSI)

Non MES+DSI

SRB storage space
Architecture Overview (cont.)

Return TURL

Web Service

Transfer to TURL

Yes, default space is ready and this file has been set to pinned.

Auxiliary Filecatalog (AMGA)

Data server management

iCAT Server (GSI enabled)

Non iCAT (+DSI)

Non iCAT (+DSI)

Non MES+DSI

SRB storage space
Architecture Overview (cont.)

Web Service

Core

Auxiliary Filecatalog (AMGA)

Data server management

iCAT Server (GSI enabled)

Non iCAT (+DSI)

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SRB storage space

Upload a file (gridftp)
Architecture Overview (cont.)

Web Service

Core

Auxiliary Filecatalog (AMGA)

Data server management

iCAT Server (GSI enabled)

Non iCAT (+DSI)

Non iCAT (+DSI)

Non MES+DSI

SRB storage space

Set this file has been uploaded and unpinned

SURL -> Path

put file done
Architecture Overview (cont.)

The Status of PutDone

Web Service

Return the Status of PutDone

Core

Auxiliary filecatalog (AMGA)

Data server management

iCAT Server (GSI enabled)

Non iCAT (+DSI)

Non iCAT (+DSI)

Non MES+DSI

SRB storage space
Support Flexible File/Space Types

• SRM system has a caching mechanism and has to take care of SRM issues like file lifetime, space management,…, etc.

• Permanent space
• Volatile space
• Durable space

• Implementation

• Use AMGA as auxiliary catalog and record all space usage, space type, and some file metadata inside.
Checking Disk Status

Web Service

Core

Data server management

• Auxiliary Filecatalog
  • (AMGA)

Update status of each resource

Resource info

Logical Resource info

iRODSInfoServer

iCAT Server (GSI enabled)

Resource info

Storage space

Resource info

Storage space
Checking Disk Status

- How to get the disk usage of the space?
  - Need to know the free and used space on iRODS server
  - iRODS provide the mechanism to monitor resource usage: SL_DISK_SPACE
  - We need to know the usage
    - Space management

- Implementation
  - iRODSInfoServer:
    - Deployed on iRODS master server
Progress

- Space Management Functions
  - srmReserveSpace
  - srmReleaseSpace
  - srmUpdateSpace
  - srmGetSpaceMetaData
  - srmChangeSpaceForFiles
  - srmGetSpaceTokens

- Permission Functions
  - srmSetPermission
  - srmCheckPermission
  - srmGetPermission

- Directory Functions
  - srmMkdir
  - srmRmdir
  - srmRm
  - srmLs
  - srmMv

- Data Transfer Functions
  - srmPrepareToGet
  - srmBringOnline
  - srmPrepareToPut
  - srmCopy
  - srmStatusOfCopyRequest
  - srmReleaseFiles
  - srmPutDone
  - srmAbortRequest
  - srmSuspendRequest
  - srmResumeRequest
  - srmGetRequestSummary
  - srmGetRequestTokens

- Discovery Functions
  - srmGetTransferProtocols
  - srmPing
Synchronous and Asynchronous

SRM service provides two classes of methods:

- **Asynchronous methods** (non-blocking call)
- **Synchronous methods** (blocking call)
Asynchronous Operations

CopyClient 1
CopyClient 2
CopyClient 3
CopyClient n

Push case
Pull case
Progress

• The 1st stage:
  • Core Functions
    • Space Management Functions.
    • Permission Functions.
    • Directory Functions.
    • Data Transfer Functions.
    • Discovery Functions.
  • AMGA DB Schema
  • iRODS Server Manager
    • iRODSInfoServer
Progress (Cont.)

- 2nd stage
  - Internal space management functions
    - Use a thread to recycle expired space
  - Asynchronous operation
    - Space functions
    - Transfer functions
References

- SRM working group:
- iRODS:
  - https://www.irods.org/
- AMGA:
  - http://amga.web.cern.ch/amga
- Globus:
  - http://www.globus.org
- CoG:
- Axis:
  - http://ws.apache.org/axis/